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THE PALEOZOIC FORMATIONS OF ALLEGANY COUNTY, MARYLAND[1]

INTRODUCTION

THE author of this paper has been engaged since the summer of 1897 as chief of the Division of Appalachian Geology of the Maryland Geological Survey in studying the geological formations of the western counties of Maryland. He has had as assistants in this work at different times Messrs. C. C. O'Harra, R. B. Rowe, G. C. Martin, A. C. McLaughlin, and A. P. Romine. Mr. Richard B. Rowe, who was already acquainted with the New York formations, reached the conclusion, as the result of his field work during 1897, that several of the Paleozoic formations of western Maryland could be correlated with those of New York. The continuation of Mr. Rowe's work, together with that of Mr. Romine, under my direction during the field seasons of 1898, 1899, and 1900 further confirmed these views.

The following account of the Paleozoic formations of Allegany county, Maryland, embraces a brief description of their character and distribution, together with a statement regarding their probable correlation with the New York and Pennsylvania formations. The report of Dr. C. C. O'Harra on "The Geology of Allegany County"[2] incorporated the revised classification of western Maryland devised by Dr. William B. Clark, the writer, and his assistants, and thus represents the conclusions, based on the field work carried on during the seasons of 1897–1900. The writer is under obligations to Professor Bailey Willis, whose manuscript on "The Appalachian Region—Paleozoic Appalachia, or the History of Maryland during Paleozoic Time,"[3] was kindly placed at his disposal, and has recently been published under the auspices of the state survey.

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[1] Published by permission of Dr. William Bullock Clark, state geologist of Maryland.

[2] Md. Geol. Survey, Allegany county, 1900, pp. 57–163.

[3] Maryland Geol. Survey, Vol. IV, 1900, pp. 23–93.

THICKNESS

The strata covering Allegany county have a thickness varying from about 13,300 to 16,000 feet. This thickness is divided between the four geological systems represented in the county in the following manner: Silurian, from 2200 to 2400 feet; Devonian, 7875 to 10,200 feet; Carboniferous, 2825 to 3000 feet, and Permian (?), about 400 feet.

SILURIAN STRATA

Juniata formation.—The oldest rocks outcropping in Allegany county belong in this formation, and are shown in only one locality. This outcrop forms the lower part of the cliffs in the gorge known as "the Narrows" just northwest of Cumberland, where Wills Creek has cut a deep and narrow trench through Wills Mountain. This gorge presents an admirable example of a narrow transverse valley where a stream has cut through a mountain ridge, and this locality has a justly deserved reputation for great natural beauty. The upper 370 feet of the formation is well shown on the northern side of the creek; but in many places in the gorge it is concealed for the most part by heavy talus of white quartzite blocks from the cliff above. In the Narrows 550 feet of the Juniata are shown, but no fossils have been found at this locality. The formation is composed of alternating beds of deep red shales and sandstones which have no regularity of succession, but show a much greater total thickness of shales than sandstones. The sandstones are hard, fine-grained, cross-bedded, and micaceous, some of the strata a foot or more in thickness, but usually less than six inches. The shales are micaceous, weathering readily, and the beds vary from an inch to six feet or more in thickness. This formation was named from the Juniata River, Pa., though in the earlier reports of that state it was termed the Medina or Levant red sandstone (No. IV*b*). It probably represents the older part of the Medina stage of New York near the base of the Upper Silurian, which, in western New York, is composed mainly of red shales.

Tuscarora formation.—This quartzitic sandstone, ·which rests conformably upon the Juniata formation, and forms the beautiful flat-topped arch of Wills Mountain is admirably shown on its western side, especially at the entrance to the Narrows, and in the upper part of the high massive cliffs bordering the gorge. It also forms the greater part of the exposed rocks in Evitt's and Tussey's mountains and two small areas along the Baltimore and Ohio Railroad near Potomac Station. The formation is a white to light gray, very hard quartzose sandstone composed of fairly coarse quartz grains cemented by siliceous material. Small pebbles of quartz and also those of yellowish-green hard clay occasionally occur. The layers are frequently very massive and cross-bedded structure is not infrequent. Its thickness varies from 250 to 300 feet, and it furnishes building stone and ballast. *Arthrophycus harlani*, a sea-weed, the only fossil found in this sandstone in the county is fairly common on the upper surfaces of the higher beds in the Narrows.

The Tuscarora formation, named from Tuscarora Mountain in Pennsylvania, was formerly called the Medina or Levant white sandstone (No. IV*c*), and represents the upper part of the Medina stage of New York. The Juniata and Tuscarora formations are probably equivalent to the Medina formation of New York, but in western New York, where it is typically represented, especially in the Niagara region, there is not such a definite separation into a lower divison composed of red shales and sandstones and an upper one composed of a white quartzose sandstone as in Maryland. In the Niagara region the Medina is composed of the following divisions named in ascending order: Lower Medina, composed of red shales only about the upper 115 feet of which is exposed in outcrop. Upper Medina, composed of seven zones: (1) 25 feet of gray quartzose sandstone; (2) 25 feet of thin gray shales; (3) five feet of gray sandstones and sandy shales; (4) 6 feet of mainly gray argillaceous shales which become reddish at the top; (5) 35 to 40 feet of mainly thin-bedded sandstone reddish in color or gray mottled with red; (6) 12 to 15 feet of massive sandstone in beds from one to several feet in thickness and varying in color from reddish to grayish; (7) at the top 7½ feet of a hard massive-bedded and compact white quartzose sandstone similar to No. 1. In some thin sandstones in the upper part of No. 6 occurs the characteristic Medina fossil known as *Arthrophycus harlani* (Conrad).[1]

Clinton formation.—The largest area of this formation flanks both sides of Wills Mountain extending to the Potomac River, while two other areas flank the southern ends of Evitt's and Tussey's mountains. The formation is composed largely of yellowish-green to reddish shales, but on weathering, the flat surfaces frequently have a scarlet tint. There are blackish shales and thin fossiliferous limestones in its upper part as well as a greenish-gray to reddish sandstone. The most important lithologic character of the formation, however, is the two beds of iron ore, the lower occurring from 120 to 160 feet above its base and consisting of two strata of iron ore separated by a band of greenish-yellow shales from 6 inches to 6 feet thick. The two ore-bearing strata have a thickness of from 10 to 12 feet. At Cumberland the upper bed of iron ore is 270 feet above the lower one, in the midst of a brownish, calcareous sandstone, nearly 3 feet thick which is directly above a massive 5-foot sandstone stratum. There are 9 inches of quite clear, fossiliferous iron ore and the overlying greenish shales and thin bands of bluish limestone also contain fossils. The thickness of the formation varies from 550 to 600 feet. Fossils are common in the middle and upper portions, some of the species being identical with those of the New York Clinton. The name is derived from the exposures at Clinton, Oneida county, N. Y., where the beds of iron ore have been mined for many years, and the stage is identical with No. V*a* of the Pennsylvania survey which is called the Rockwood formation in the Piedmont folio of the U. S. Geological Survey.

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[1] For an excellent account of the Medina formation along the Niagara River, see Bull. N. Y. State Museum, No. 45, 1901, pp. 87–95 and accompanying geological map by Dr. Amadeus W. Grabau.

Niagara formation.—This formation surrounds the three areas mentioned under the Clinton formation. The lower part consists of thin-bedded, blue limestones with thin shale partings; but in the upper part the shales predominate and become blackish in color. The thickness varies from less than 250 to fully 300 feet. The thin limestones contain brachiopods and other fossils, some of which are specifically identical with the Niagara fossils. The formation is named from the admirable exposures at Niagara Falls and represents No. V*b* of the Pennsylvania survey and the lower part of the Lewistown formation of the Piedmont folio. The revised classification of the New York series by Messrs. Clarke and Schuchert, however, drops the Niagara formation or group and returns to the earlier classification of Rochester shale, Lockport limestone, and Guelph dolomite.[1]

There has been more or less uncertainty regarding the identification of the Niagara limestone south of New York; but recently Dr. Weller has conclusively shown that the Decker Ferry formation of western New Jersey and eastern Pennsylvania is of the same age "as the Rochester shale and Lockport limestone of Clarke and Schuchert, or as the Niagara formation of most authors."[2] A small collection of fossils from the beds near Cumberland was submitted to Dr. Weller who kindly examined them and wrote that his impression is that they are the same as the Decker Ferry formation, and in New Jersey there are sufficient authentic Niagaran species to definitely refer the formation to the Niagaran. In conclusion he stated that "I should think you would be fully justified in considering the Cumberland fauna as of Niagaran age."[3] Mr. Schuchert has studied these beds in the field as well as their fossils and he positively correlates them with the Niagara. His statement is that

[1] Science, N. S., Vol. X, 1899, p. 876.

[2] Geol. Surv. N. J., Ann. Rept. for 1899–1900, p. 18, and also see p. 20.

[3] Letter of May 29, 1901.

"there are beds at Cumberland, Md., holding a fauna of the age between the Lockport [Rochester?] shale and the Guelph of New York and Ontario. This fauna has its peculiarities, but the aspect is certainly not Clinton."[1]

Salina formation.—This formation borders the Niagara but the rocks are largely concealed over most of the areas except along Wills Creek in Cumberland, Flintstone Creek at Flintstone, and the Baltimore and Ohio Railroad near Potomac Station, where one finds the best exposure. In the Potomac section there are four cement beds which have great economic value, the lowest one situated about twenty-five feet above the base of the formation. Fifty feet of the succeeding 140 feet of the formation is composed of the four cement beds which are separated by shales and impure limestones. Succeeding the upper cement bed are 450 feet or more of gray shales, drab and blue limestones and sandstone, the limestones predominating.[2] The thickness is about 700 feet. Fossils are not common. The formation was named from Salina in central New York and is represented by No, V*c* of the Pennsylvania survey and the second part of the Lewistown formation of the Piedmont folio.

The statement has been made that "the geological reader will wonder on what basis the name Salina is applied to the rocks so described" in Maryland.[3] It is perhaps sufficient to state that Professor Lesley, the former state geologist of Pennsylvania and admirable stratigraphical geologist, correlated the corresponding rocks of Pennsylvania with the Salina. In Bedford county, Pennsylvania, which lies immediately north of the Cumberland region, Professor Lesley gave the upper and middle divisions of the Salina as 628 feet in thickness to which is to be added a portion of the 472 feet composing the lower Salina which included the Niagara beds at its bottom.[1] Mr. Schuchert also fully concurs in correlating these Maryland beds with the Salina.

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[1] Letter of June 26, 1901.

[2] Mr. Schuchert has recently studied this formation in the Cumberland region and he writes me as follows: "I am inclined to cut out of the Salina the lower 23′ 6″ as given on p. 93 of O'Harra's report (Maryland Geological Survey, Allegany county). This thickness I now refer to the rest of the Niagara. I also extend the Salina a little higher, making the total thickness 704′." (Letter of June 26, 1901.)

[3] Am. Jour. Sci., 4th ser., Vol. XI, p. 240, 1901.

DEVONIAN STRATA [2]

Helderberg limestone.— The largest area covered by this formation is in the central part of the county which it enters to the north of Flintstone and then runs in a zigzag manner back and forth until it leaves the county on the western side of Evitt's Mountain. Another area follows Shriver Ridge and passes through western Cumberland across the county. A third area enters in the eastern part of Wills Creek valley and runs across the county, keeping west of Wills Mountain, to Potomac Station; and, finally, to the southwest is the Fort Hill area, beween Rawlings and Dawson. The best localities for studying this formation are the Devil's Backbone, northwest of Cumberland; the cliff on the West Virginia side at Cedar Cliff and the Baltimore and Ohio Railroad cut near Potomac Station. The lower 400 feet of the formation is composed of fairly thin-bedded bluish-gray limestones, separate pieces of which have a metallic ring when sharply hit. The more shaly layers contain fossils among which are *Tentaculites gyracanthus* and *Spirifer vanuxemi*, characteristic species of the Tentaculite limestone in New York with which this zone is correlated.

Messrs. Clarke and Schuchert in their revised classification revived Vanuxem's geographical name of Manlius limestone for the paleontological one of Tentaculite limestone.[3] The Maryland zone was put in the Helderbergian instead of the Cayugan period because, as clearly stated by Dr. O'Harra, "the lithological break between it and the Salina is very marked and can be followed in the field . . . . while there is no lithological break between the Tentaculite and Lower Pentamerus subformations, and the division for mapping purposes cannot be made here."[4]

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[1] Summary Description Geol. Pennsylvania, Vol. II, p. 839, 1892.

[2] The Geological Survey of Maryland has followed Dr. Clarke and Mr. Schuchert in referring the Helderbergian period to the Devonian system.

[3] Science, N. S., Vol. X, pp. 876, 877, 1899.

[4] Allegany county, p. 96.

Higher in the formation are massive darker blue limestones, about 240 feet in thickness according to Schuchert or from 50 to 150 feet as given in Rowe's report, some of the layers of which contain numerous specimens of *Pentamerus* (*Sieberella*) *galeatus*. This zone probably represents the Lower Pentamerus limestone of New York, of which the above fossil is a characteristic species.

In place of the paleontological name Lower Pentamerus limestone, Messrs. Clarke and Schuchert proposed Coeymans limestone.[1]

In the upper fifty feet or more of the limestones are frequent specimens of *Spirifer macropleurus* characteristic of the Delthyris shaly limestone of New York, with which this zone is correlated. In New York this division of the Helderberg consists of calcareous shales and shaly limestones with some beds a foot or more in thickness, but in Maryland it is composed mainly of fairly massive limestone. With the exception of the Lower Pentamerus, all the Helderberg limestones are more massive in Maryland than in New York. In place of the term Catskill or Delthyris shaly limestone Messrs. Clarke and Schuchert proposed the geographic name of New Scotland beds.[2]

The Becraft limestone, which caps the Helderberg limestone of New York, is apparently not represented in Allegany county, although some eighty-five feet of it occurs farther east in Washington county, Md.

The thickness of the foundation varies from 750 to 900 feet, and fossils are common in some of the layers. The limestones are valuable for quicklime, ballast, road-metal, and building purposes. The formation is named from the lower limestones of the Helderberg Mountains in eastern New York, and is the equivalent of No. VI of the Pennsylvania survey, and the upper part of the Lewistown formation of the Piedmont folio.

Oriskany sandstone.—The easternmost area of Oriskany sandstone is that of Stratford Ridge, to the northeast of Oldtown; then follows that of the central part of the county bordering the zigzag Helderberg area; then, in order named, that crossing the county along the eastern side of Shriver Ridge; the narrow band extending across the county to the west of the Helderberg area west of Wills Mountain; to the southwest the band on the western side of Fort Hill, and, lastly, the area extending from the Twenty-first Bridge to Monster Rock at Keyser.

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[1] Science, N. S., Vol. X, pp. 876, 877.

[2] *Ibid.*, pp. 876, 877.

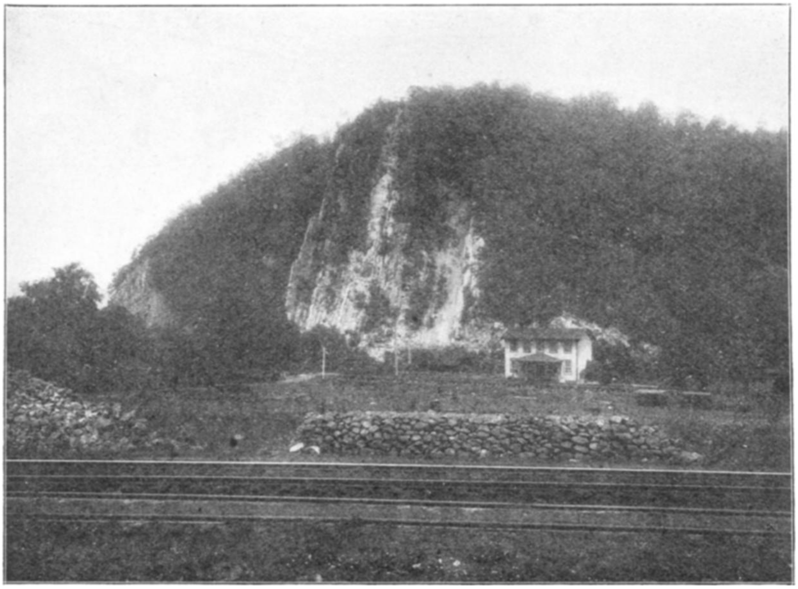

FIG. I.—Devil's Backbone, near Cumberland, showing Helderberg limestone in the steeper part and Oriskany sandstone in the farther railroad cut.

The lower part of the formation is mainly a bluish-black cherty limestone, 75 to 100 feet in thickness, the chert in nodules and layers, with some dark gray arenaceous shales; and the remainder of the formation is mostly a sandstone, frequently calcareous, and varying in color from gray to white, about 250 feet in thickness. Toward the top there are a few bands varying from grit to conglomerate. The sandstone, on account of its calcareous cement, weathers readily to a friable brownish or buff, porous rock, which, when protected from erosion eventually forms beds of sand. Its thickness varies from 325 to 350 feet. It furnishes railroad ballast and good glass sand. Fossils occur abundantly in zones varying in thickness from an inch to several feet. The most perfect specimens may be obtained from the beds of sand from the disintegrated rock, and frequently from pockets of sand in the partly weathered rock. *Spirifer arenosus* and other common species of the formation in New York are abundant, together with species which are restricted to its southern distribution. There are numerous springs along the contact of the Helderberg and the Oriskany sandstone. The formation is named from outcrops near Oriskany Falls, in central New York; is known as No. VII in Pennsylvania; and is the Monterey sandstone of the Piedmont folio.

Romney formation.—This formation enters the county on the eastern side of Iron Ore Ridge, northeast of Flintstone, crosses it and covers a large area to the east, north, and west of Oldtown, then alternates with the Oriskany areas in the southern central part of the county, and finally crosses in a V-shaped area—the eastern arm west of Nicholas Mountain, the point along Evitt's Creek, and the western arm passing through the eastern part of Cumberland. The western area enters the county at Ellerslie, crosses it to the Potomac River, and then extends southwest to the bend in the river at Keyser, W. Va.

The transition from the Oriskany sandsone to the black shale of the Romney is very abrupt, as may be seen at various exposures of the contact, especially east of the church on the Williams Road, two and one half miles southeast of Cumberland, and at Monster Rock on the W. Va. Central Railroad, near Keyser, W. Va. The lower part of the formation is composed of thin black shales, weathering to a rusty brown, in which are some bands of bluish-gray limestone about 150 feet above the base. This portion of the formation is well shown in the two railroad cuts just north of the Twenty-first Bridge on the Baltimore and Ohio Railroad. The black shales contain specimens of *Liorhynchus limitaris* and other small fossils, and in lithological characters agree with Marcellus shale of New York or No.

VIII*b* of Pennsylvania, which they represent. The higher rocks are drab and bluish argillaceous to arenaceous shales and thin sandstones, which usually weather to an olive or yellowish-gray tint. At certain localities they are very fossiliferous, containing numerous specimens of *Spirifer granulosus*, *S. mucronatus*, *Athyris spiriferoides*, *Tropidoleptus carinatus*, *Chonetes coronata*, *Phacops rana* and other characteristic species of the Hamilton formation of New York, the fauna amounting to about 150 species. The formation, which varies in thickness from 1600 to 1650 feet, is named from the exposures near Romney, in northeastern West Virginia, and represents the Marcellus shale and Hamilton beds of New York, and No. VIII*b* and *c* of Pennsylvania.

In 1842 Emmons proposed the name Erie group for all the New York rocks between the base of the Marcellus shales and the top of the Chemung.[1] Mr. Darton, in 1892, proposed and defined the Romney shales, named from exposures in the vicinity of Romney, Hampshire county, in northeastern West Virginia,[2] which are now known to be equivalent to the Marcellus shales and Hamilton beds of New York. Messrs. Clarke and Schuchert, in 1899, used the term Erian in their revised classification of the New York series for the group composed of the Marcellus shales and Hamilton beds, and stated that it represented the "Erie Division" revived with a restricted meaning.[3]

It appears that the Romney formation is equivalent to the Erian group of New York; but the writer is undecided as to which name the laws of nomenclature entitle to recognition in Maryland.

Jennings formation.—The eastern area crosses the eastern part of the county from the northeast to the southwest; the second area lies to the west of Green Ridge, and in its northern half covers a large district to the north and east of the Romney formation; the third covers the lower part of Evitt's Creek valley between the two arms of the V-shaped Romney area, and the fourth one is the broad band covering the lower part of the eastern face of Alleghany Front and extending from the Pennsylvania line southwesterly to the Potomac River above Keyser, W. Va. The lower part of the formation composed of thin, black, argillaceous shales in which a few species, such as *Buchiola speciosa*, *Lunulicardium fragile*, and *Styliolina fissurella* are common, immediately succeeds beds containing characteristic Hamilton fossils, and is well shown on Flintstone Creek, a few rods above its mouth, opposite the old Flintstone tannery; by the side of the National Road three miles northeast of Cumberland to the west of Evitt's Creek at Folks Mill, and on the Williams road east of Cumberland. This subformation corresponds in lithologic character and stratigraphic position to the Genesee shale of New York and No. VIII*e* of Pennsylvania.

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[1] Geology, New York, Pt. II, pp. 100, 429.

[2] Am. Geologist, Vol. X, pp. 17, 18.

[3] Science, N. S., Vol. X, pp. 876, 877.

Following this are olive to bluish fine argillaceous shales alternating with thin bedded sandstones. A few fossils occur in the more bluish layers. This division of the Jennings corresponds to the Portage formation of New York, or that facies named the Naples beds by Dr. Clarke, and No. VIII*f* of Pennsylvania. Dr. J. M. Clarke, who has described the Jennings fauna for the Maryland Geological Survey, writes me that the fauna of these two lower divisions of the Jennings formation "is very distinctly that of the Naples subprovince;" and he states that the lower division is considered "as an integral part of the Naples beds, bearing the Naples fauna."[1]

Succeeding the Portage are greenish arenaceous shales weathering to a buff color alternating with thin micaceous sandstones. Occasional layers are fossiliferous and the characteristic Chemung species, *Spirifer disjunctus*, is not uncommon. The lithological appearance of this part of the formation is quite similar to that of a considerable part of the Chemung in southwestern New York. Higher the sandstones predominate, and these vary in color from yellowish-gray through brownish-gray to dark red, and vary in texture from sandstone and grits to a white pebble conglomerate. Some of these sandstones are quite massive, and in Jennings Run about one and one half miles above Corrigansville, a zone of grit and sandstone is thirty-five feet thick. The red rocks increase above this horizon, but Chemung fossils including *Spirifer disjunctus* extend some 650 feet higher, and the line between the Jennings and Hampshire formations has been drawn at the top of this fauna. The formation is between 3800 and 4000 feet in thickness. The upper part of the Jennings may be correlated with the Chemung of New York or No. VIII*g* of Pennsylvania.

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[1] Letter of June 19, 1901.

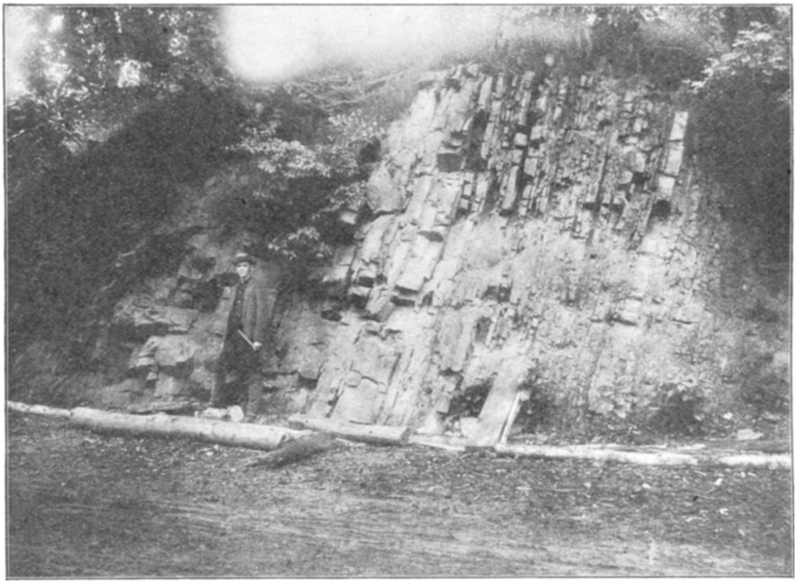

FIG. 2.—Heavy sandstone and conglomerate beds in the upper part of the Jennings formation, as shown by the roadside above Corriganville.

Hampshire formation.—This formation crosses the extreme eastern part of the county from the northeast to the southwest; the next area, which is the largest, flanks each side of Town Hill and crosses the county in the same general direction; while the third extends along the middle part of the eastern face of Alleghany Front. The rocks consist mainly of an alternation of red, flaggy, and massive sandstones and arenaceous or argillaceous shales which both laterally and vertically merge gradually into each other and in the upper part of the formation shales, some of which are gray, and some brown in color, predominate. Some of the sandstones are crossbedded, and in the lower part of the formation, massive. The thickness varies from 1900 to 2000 feet. Fossils occur very infrequently. The formation is named from Hampshire county in northeastern West Virginia, a considerable area of which is underlain by it, and it represents at least part of the Catskill formation of New York, or No. IX of Pennsylvania.

CARBONIFEROUS STRATA

Pocono sandstone—The most eastern area of this formation, which forms the upper part of Town Hill, is mainly a massive conglomerate, while in the western area, extending across the county from Pennsylvania to West Virginia along the eastern face of Alleghany Front, the lower part of the formation is a coarse-grained, grayish-green, micaceous sandstone. Near the middle are shales containing fragments of plants, and the upper part is a grayish-green or reddish-green, micaceous, flaggy sandstone with some interbedded shales of various colors. Some of the layers are cross bedded and others are conglomeratic. The thickness varies from 400 to 450 feet, and fragments of plants are the only fossils noted with the exception of a few shells apparently from this formation which were found nine miles northeast of Oakland, Garrett county. The formation is named from Pocono plateau in northeastern Pennsylvania, and is No. X of the Pennsylvania reports.

Greenbrier limestone.—This formation crosses the county as a narrow band along the eastern face of the Alleghany Front from Pennsylvania to West Virginia. The best exposures are in Jennings Run above the railroad water-tank; and on the north bank of the Potomac River below the mouth of Stony Run, as well as in the lower part of the run, two miles below Westernport. The lower part of the formation is composed largely of bluish-gray, arenaceous limestone, the middle of red and olive shales and the upper part of massive bluish-gray limestones and calcareous shales. The limestone is valuable for road-metal and in Garrett county is quarried and burned to a considerable extent for quicklime which is used as a fertilizer. The thickness varies from 200 to 250 feet and the upper part is quite fossiliferous. The formation is named from Greenbrier county in southeastern West Virginia where it reaches a thickness of 1000 feet or more.

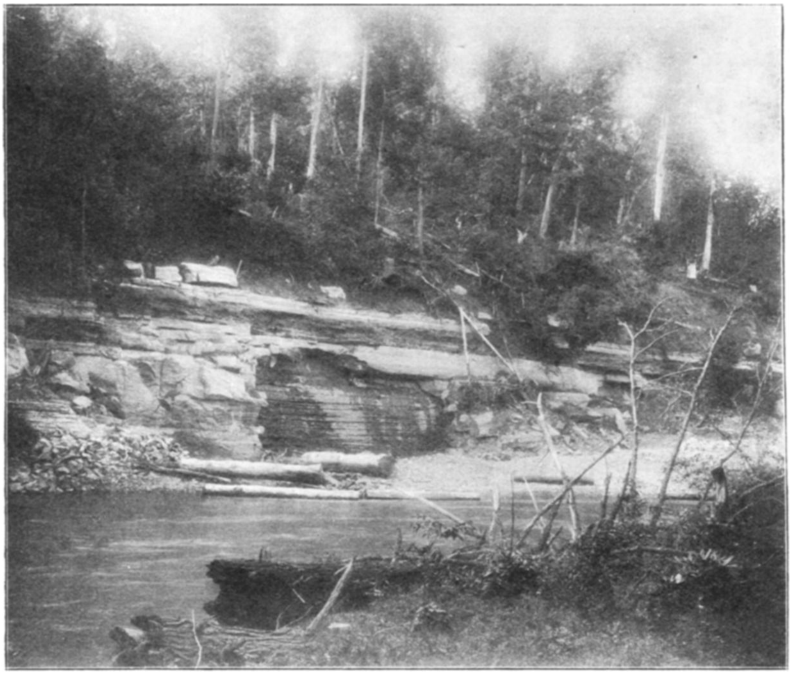

FIG. 3.—Greenbrier limestone on western bank of Youghiogheny River, southwest of Oakland, Md.

Mauch Chunk formation.—This, like the preceding formation, crosses the county along the eastern face of Alleghany Front but the band is broader, covering the upper part of the mountain slope. The rocks are mainly red arenaceous and argillaceous shales and sandstones, but a little above the middle of the formation is about 100 feet of reddish thin-bedded standstones. At the top of the formation, as shown in the Cumberland and Pennsylvania R. R. cut east of Barrelville, is a greenish zone five feet thick composed partly of sandstone and partly of a calcareous breccia containing clay pebbles. The thickness of the formation is 650 feet. In the lower part of the shales and along the Greenbrier–Mauch Chunk contact are numerous excellent springs. The formation is named from Mauch Chunk in eastern Pennsylvania and is the Canaan formation of the Piedmont folio. The Greenbrier limestone and Mauch Chunk shales taken together are known as No. XI of the Pennsylvania reports.

Pottsville formation.—The preceding three formations are usually grouped together as the sub-Carboniferous or Lower Carboniferous, and the Pottsville is classed as the oldest of the Carboniferous proper or Upper Carboniferous formations. It crosses the county from Pennsylvania to the Potomac, in general forming the crest line of Alleghany Front although in the northern part it is lower, and extends up the Potomac valley to above Westernport. At numerous places near the crest line of Alleghany Front it forms conspicuous cliffs. It also occurs at the northwestern corner of the county. The formation is composed of massive light gray sandstones with some conglomerate strata and thin-bedded gray sandstones and shales. Some of the shales are black and there are several thin beds of coal. The most important are first, the Bloomington, which is exposed along the Baltimore and Ohio Railroad west of Piedmont, W. Va., commonly known as the Railroad seam, varying in thickness from less than two to more than three feet and occurring about 150 feet below the top of the formation. The second is the Westernport seam about two feet thick which occurs below the Homewood sandstone near the top of the formation. Some of the sandstones are suitable for building stone. The thickness is estimated as between 450 and 500 feet and there are fragments of fossil plants. The formation is named from the exposures of massive conglomerate in the vicinity of Pottsville in eastern Pennsylvania. It is the Blackwater formation of the Piedmont folio and No. XII of the Pennsylvania reports.

Allegheny formation.—This is the first of the Coal-measure formations and in general covers the western slope of Alleghany Front extending from Pennsylvania to the Potomac valley and up it into Garrett county. It also extends up George's Creek valley from Westernport to the vicinity of Morrison's, one mile below Barton; and occurs in the northwestern corner of the county. The rocks consist of massive to thin-bedded grayish to olive sandstones, gray and black shales and beds of fire-clay and coal. At Barrelville and on the northern part of Dan's Mountain two coal beds occur near the base of the formation which have not been found near Westernport. The lower one, called the "Bluebaugh" (Brookville) coal, varies in thickness from 2½ to 4½ feet and 30 feet or more above it is the "Parker"

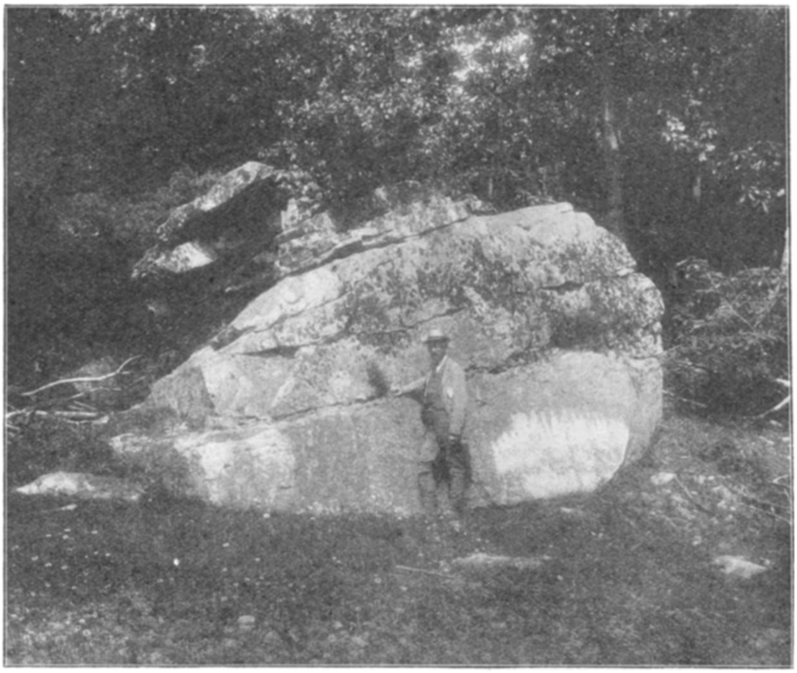

FIG. 4.—Block of Pottsville conglomerate, at side of National Road on top of Meadow Mountain, Garrett Co.

(Clarion) coal with a thickness of two feet which was reported by the miners to reach 4½ feet. At Westernport nearly 100 feet above the base is an impure coal, called the "Split six-foot" by the miners, showing a thickness of 4 feet, and 130 feet above the base is the most valuable coal seam of this formation, the "Davis" (Lower Kittanning), commonly known as the "Six-foot," with a thickness of about 5 feet in the lower George's Creek valley. Nearly 170 feet above the Davis seam is the "Thomas" (Upper Freeport) coal, which forms the top of the formation, and from its general thickness in the George's Creek valley is known as the "Three-foot" seam. Fossil shells have been found in the black or bluish shales at a few localities. The thickness of the formation is about 300 feet. It is named from the exposures on the Allegheny River in western Pennsylvania, is very generally called the Lower Productive-measures, is No. XIII of the Pennsylvania survey and includes the Savage formation and lower part of the Bayard of the Piedmont folio.

Conemaugh formation.—The area south of the Pennsylvania line to a parallel line passing through Little Alleghany and to the west of the foot of the western slope of Little Alleghany and Piney mountains is largely covered by this formation. Then it extends parallel to Dan's Mountain, to the southwestern part of the county and covers a large portion of the steep slopes of the hills bordering the lower George's Creek valley, continuing up the valley to Ocean. It also appears in the upper part of a number of the small valleys along the western border of the county. The lower part of the formation, representing the Mahoning sandstone, is frequently a massive gray sandstone with bands of yellowish shales reaching a thickness of about 100 feet. In the upper part of this sandstone, about eighty-five feet above the Thomas coal, is a coal seam about two feet in thickness underlain by a stratum of fire clay. The succeeding rocks are grayish to brownish sandstones and yellowish to gray and black arenaceous and arigillaceous shales with beds of coal and fire clay. In some of the localities there are quite massive gray to brownish-gray sandstones near the middle and top of the formation. From 225 to 230 feet above the Thomas coal and base of the formation and about 400 feet below the Elkgarden coal is a coal seam with a general thickness of four feet, but varying from three to nearly five feet, named the Barton (Four-foot) coal, and worked to a considerable extent in the vicinity of that town. A thin seam nearly one foot thick in outcrop occurs about 440 feet above the Thomas coal or 220 feet below the Elkgarden, while approximately 500 feet above the Thomas coal and 150 feet below the Elkgarden coal is a zone composed of alternating shales and impure coal, varying in thickness from seven to ten feet, known locally as the "Dirty Nine-foot" and called the "Franklin" coal. In the Lonaconing section, thirteen feet below the base of the Franklin coal are nearly three feet of coal and black, thin shale. There are also two or three impure limestone strata and some irregular beds of iron ore. The formation is clearly defined by the top of the Thomas coal at the base and the base of the Elkgarden (Pittsburg) coal at the top, the thickness varying from 600 to nearly 640 feet. A few invertebrate fossils have been found, principally on the bank of George's Creek at Barton, and fossil plants in the black shales.

The Conemaugh formation was named from the Conemaugh River in western Pennsylvania, is frequently called the Lower Barren-measures, is No. XIV of the Pennsylvania reports, is the upper part of the Bayard and Fairfax formation of the Piedmont folio, and the Elk River series of West Virginia.

Monongahela formation.—This formation, south of an east and west line passing through Little Alleghany, covers the larger part of George's Creek valley as far south as Ocean and most of the area west to the county line. To the north of Little Alleghany, two high hills are capped by it. From Ocean to Lonaconing the upper part of the steep hills bounding the George's Creek valley are in the Monongahela, which also caps most of the highest hills as far south as Hampshire to the northeast of Westernport. The rocks consist largely of light gray to black shales with some grayish sandstones which form occasional massive strata. There are also several dark colored limestones, bands of iron ore, and beds of coal. The Elkgarden (Pittsburg) coal, the noted seam of western Maryland, and known locally as the "Big Vein" or "Fourteen-foot" seam, occurs at the base of this formation. The main mass of coal varies in thickness from ten to nearly fourteen feet, above which are frequently from three to nine feet of alternating coal and black shale which, in the southern part of the George's Creek field, is capped by twenty-five feet of thin black shales in which coal occasionally occurs.

A seam of coal two and one half feet in thickness is reported in the Consolidation Coal Company's new shaft 92 feet above the base of the Elkgarden coal. From 120 to 140 feet above the top of the Elkgarden is the Tyson (Sewickley) coal varying in thickness from three to seven feet. Finally, at the top of the formation about 255 feet above the base of the Elkgarden coal is the Koontz (Waynesburg) coal two feet thick and reported to reach a thickness of four and one half feet. The top of this coal determines the upper limit of the Monongahela formation which has a thickness of a little more than 250 feet. Fossils are rare.

The Monongahela formation was named from the exposures along the Monongahela River in southwestern Pennsylvania, is popularly known as the Upper Productive-measures, is No. XV of the Pennsylvania reports and the Elkgarden formation of the Piedmont folio.

PERMIAN STRATA (?)

Dunkard formation.—The largest area of this formation partly underlies the city of Frostburg and covers a considerable tract to the east and southeast of the city. It covers the high part of several hills to the south of Frostburg, extending as far south as Detmold Hill on the western side of George's Creek and the hill south of Pekin on the eastern side. The rocks consist largely of argillaceous shales, which when weathered are reddish-green, with some beds of sandstone, limestone, and coal. A stratum of coal and black shale four feet thick occurs 120 feet above the base of the formation and a drab limestone, five feet thick, weathering buff occurs about 295 feet above it. This limestone, some of the layers of which contain plenty of specimens of Ostracods (*Primatia frostburgensis* Jones) and a few other species, has been quarried to some extent toward the top of Vale's Hill, east of the Consolidation Coal Company's pumping station, and it is succeeded by thin black shales. The top of the hill is ninety feet higher and on its slope forty feet above the limestone ledge are loose pieces of bluish thin-bedded limestone containing small Ostracod and Gastropod shells. Near the top are loose blocks of coarse-grained sandstone which probably caps the hill. This hill shows about 390 feet of the Dunkard formation, which is probably its greatest thickness in the county. In addition to the fossils noted in the limestones, ferns were found in the shales overlying the Koontz coal.

The formation is named from the exposures along Dunkard Creek, near the West Virginia-Pennsylvania line, is frequently called the Upper Barren-measures, and is No. XVI of the Pennsylvania report.

CHARLES S. PROSSER.

COLUMBUS, O.,
July 1901.